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Application of

Applicant(s) : Tate et al.

Title : MEAT PROCESSING SCHEME

Docket No. : SPT 0009 PA

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Assistant Commissioner for Patents
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Legal Secretary

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MEAT PROCESSING SCHEME

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application is related to U.S. Patent Application Serial No. 09/444,821, filed November 22, 1999. This application claims the benefit of U.S. Patent Application Serial No. 60/209,702, filed June 5, 2000.

BACKGROUND OF THE INVENTION

The present invention relates to meat processing and, more specifically, to tenderization and sterilization of meat products via rapid decompression. Meat is a natural product and is subject to wide variation in its properties. Meat is also subject to bacterial contamination.

Given the enormous size of the meat industry, there exists a powerful economic incentive to produce tender meat because it commands a substantially higher price than tough meat. Historically, tender meat has been produced mainly by genetic selection and animal husbandry practices that maximize tenderness. More recently, mechanical and chemical processes have been developed for tenderizing meat. These more recent meat tenderization schemes have significant drawbacks involving safety issues, process complexity, and cost. There is also a powerful economic incentive in the meat industry to prevent contamination of meat because contaminated meat is dangerous and presents significant liability problems. Accordingly, there is a continuing drive in the meat industry to develop optimal and cost effective meat processing schemes that increase tenderness and reduce risk of contamination.

BRIEF SUMMARY OF THE INVENTION

This need is met by the present invention wherein an improved scheme for processing meat is provided. In accordance with one embodiment of the present invention, a method of processing meat is provided. According to the method, a meat product is positioned within an interior volume of a decompression chamber. The interior volume of the decompression chamber is pressurized. The decompression chamber is then rapidly decompressed. The rate of

the rapid decompression defines a magnitude suitable for processing the meat product positioned within the interior volume of the decompression chamber.

In accordance with another embodiment of the present invention, a method of processing meat is provided. According to the method, a meat product is positioned within an interior volume of a decompression chamber. A pressure differential is created across a gas output in communication with the interior volume of the decompression chamber. The decompression chamber is then rapidly decompressed by transferring gas from the interior volume of the decompression chamber through the gas output. The pressure differential and the rate of the rapid decompression are selected to be suitable for processing the meat product positioned within the interior volume of the decompression chamber. Typically, the pressure differential and the rate of rapid decompression are selected to be suitable for tenderizing the meat product, killing microorganisms in the meat product, or both.

The meat may be further processed by recreating the pressure differential following the rapid decompression and repeating the rapid decompression. The pressure differential may be created by introducing compressed gas into the interior volume of the decompression chamber or by maintaining the interior volume of the decompression chamber near atmospheric pressure and placing the gas output in communication with a vacuum chamber below atmospheric pressure.

In accordance with yet another embodiment of the present invention, a meat processing apparatus is provide. The apparatus comprises a decompression chamber, a gas output, and a decompression valve. The decompression chamber defines an interior volume and is configured to permit a meat product of substantial size to be placed within and removed from the interior volume. The gas output is in communication with the interior volume of the decompression chamber. The decompression valve is arranged along the compressed gas output and is configured to (i) enable creation of a pressure differential across the decompression valve with a relatively positive pressure within the interior volume of the decompression chamber and (ii) enable rapid decompression of the decompression chamber through transfer of gas from the interior volume of the decompression chamber through the decompression valve. The pressure differential and the rate of the rapid decompression define magnitudes suitable for processing a meat product positioned within the interior volume of the decompression chamber.

Accordingly, it is an object of the present invention to provide a scheme for processing a meat product by rapid decompression of the meat product. Other objects of the present invention will be apparent in light of the description of the invention embodied herein.

BRIEF DESCRIPTION OF THE DRAWING

The following detailed description of the preferred embodiments of the present invention can be best understood when read in conjunction with Fig. 1, which is a general schematic illustration of a meat processing apparatus according to the present invention.

DETAILED DESCRIPTION

The scheme for processing meat according to the present invention may be executed with a variety of meat processing apparatuses including, but not limited to, the meat processing apparatus **10** illustrated in Fig. 1. Accordingly, the present invention is illustrated herein with primary reference to the method by which meat products may be processed.

According to the present invention, meat is processed by positioning a meat product **20** within an interior volume **30** of a decompression chamber **40**. A pressure differential is created across a gas output **25** in communication with the interior volume **30** of the decompression chamber 40. The decompression chamber 40 is rapidly decompressed by transferring gas from the interior volume **30** of the decompression chamber 40 through the gas output **25**. Preferably, the gas is transferred by opening a high-speed decompression valve **35**. The meat product **20** may be further processed by recreating the pressure differential following the rapid decompression and repeating the rapid decompression. This sequence may be executed a plurality of times, until the desired processing result is achieved. It is noted that, although an unfrozen meat product may respond more favorably to the decompression process of the present invention, the meat product **20** may be frozen or unfrozen.

The decompression chamber **40** is configured to permit a meat product **20** of substantial size to be placed within and removed from the interior volume **30**. For the purposes of describing and defining the present invention, it is noted that a meat product of substantial size comprises a meat product that is at least large enough to constitute a single serving for human consumption. It is contemplated that the decompression chamber **40** of the present invention

will have a capacity sufficient to permit treatment of a meat products ranging from about 0.1 kg to over 25 kg. It is also noted that the meat processing apparatus **10** is configured such that the meat product may be repeatedly placed in and removed from the decompression chamber **40** without significant destruction of the apparatus **10** to enable repeated or successive meat treatments. To this end, the meat processing apparatus **10** preferably includes a port **50** for loading and unloading the meat product **20**. Preferably, the load/unload port **50** defines a reusable high-pressure seal.

The specific structure of the high-speed valve **35** is not critical to the present invention. Rather, the high-speed valve need only be configured to permit rapid decompression of the decompression chamber. The high-speed valve **35** illustrated in Fig. 1 comprises a rupture disc **42** clamped between flanges **44** of the decompression chamber 40 and gas output **25**. Typically, the flanges **44** are forcibly held together by bolts, external "C" clamps, toggle clamps, etc.

The thickness and material properties of the rupture disc **42** are chosen to burst when a predetermined pressure differential is created across the disc **42**. The pressure differential at which the disc will burst is optimized to produce the desired processing effect. Typical materials are metals, such as annealed aluminum or steel, but could include any gastight material having the proper bursting pressure, such as plastic. A variety of rupture discs having different bursting pressures may be used for different meats or cuts of meat.

After the meat product **20** has been placed in position, a compressed gas supply valve **45** is opened to admit compressed gas from a compressed gas supply to the interior volume **30** of the decompression chamber **40**. The supply valve **45** may be any kind of valve, for example a manually or electrically operated valve. The size and opening speed of supply valve **45** are selected to permit pressurization of the required volume in a reasonable time - for example, less than a minute. Where a rupture disc **42** is used as the high-speed valve **35**, the compressed gas supply must supply a pressure in excess of the bursting pressure of rupture disc **42**. As a practical matter, the pressure of compressed gas supply must be substantially higher than the bursting pressure of rupture disc **42** in order to pressurize the volume under rupture disc **42** in a reasonable period of time.

For tenderizing meat, the pressure differential may be about 100 to about 300 pounds per square inch (about 650 kPa to about 2000 kPa) or may be any other suitable value. For

sterilizing meat or killing any microorganisms present in the meat, the differential may be determined experimentally. Where meat at atmospheric pressure is decompressed to a vacuum, the pressure differential is about 100 kPa. Similarly, although the rate of decompression typically exceeds about 70 MPa/sec, it is noted that the rate may vary, depending upon the specific processing goal and the specific meat product to be processed. For the purposes of describing and defining the present invention, it is noted that "rapid" decompression is utilized herein to refer to decompression rates equal to or above about 10 MPa/sec. It is contemplated that significant tenderization of a meat product may be achieved at a decompression rate between about 10 MPa/sec and about 350 MPa/sec.

The supply valve **45** may be left open until the high-speed valve **35** is opened. It is economically advantageous to close the supply valve rapidly after the high-speed valve is opened to conserve the compressed gas supply. After the flow of gas has been shut off, the apparatus may be partially disassembled for replacement of the rupture disc **42** (if used) and removal of the meat **20**, unless it is intended to subject the meat **20** to additional explosive decompressions.

The thickness and material properties of the decompression chamber **40** are chosen to withstand the pressure to be created therein, with a suitable safety factor. The decompression chamber **40** should also be constructed of a material that allows cleaning and sterilizing in accordance with meat packing industry sanitary practices. Typical materials may be stainless steel or aluminum.

The specific structure of the gas output **25** is also not critical to the present invention. Preferably, the upper end of the output **25** is open to the atmosphere. In some embodiments of the present invention, the output **25** does not have to withstand the pressure to which the decompression chamber **40** is subjected, it merely directs the air or gas blast resulting from bursting of the rupture disc, as well as any rupture disc fragments, in a safe direction. It should be noted that the functioning of the apparatus shown in Fig. 1 is independent of orientation. The vertical orientation shown in Fig. 1 is convenient since the meat **20** lies at the bottom of decompression chamber by gravity and the blast is directed upward, away from personnel in the vicinity. It is contemplated that a plurality of gas outputs **25** may be provided to increase the rate of decompression.

According to the configuration of the present invention described above with reference to Fig. 1, the pressure differential is created by introducing compressed gas into the interior volume **30** of the decompression chamber **40**. However, it is contemplated by the present invention that the pressure differential may also be created by maintaining the interior volume **30** of the decompression chamber **40** near atmospheric pressure and placing the gas output **25** in communication with a vacuum chamber (not shown) below atmospheric pressure. According to this configuration, the meat product **20** is not subject to pressures above atmospheric pressure and may be processed by rapidly decompressing the chamber **40** to a value below atmospheric pressure. It is noted that, in this embodiment of the present invention, the volume of the vacuum chamber will preferably exceed significantly the volume of the decompression chamber **40**.

The interior volume **30** of the decompression chamber **40** may be filled with a gas designed to inhibit spoilage of the meat product **20**. Additionally, or alternatively, the decompression chamber **40** may be filled with an oxygenating gas having a composition selected to enhance the color of the meat product. The spoilage inhibiting gas may comprise, for example, substantially pure carbon dioxide. The oxygenating gas may comprise, for example, substantially pure oxygen.

As is noted above, the meat processing scheme of the present invention may be executed with a variety of meat processing apparatuses including, but not limited to, the meat processing apparatus **10** illustrated in Fig. 1. Some alternatives to the meat processing apparatus **10** illustrated in Fig. 1 will achieve rapid decompression by using an alternative to the rupture disc **42**. For example, the high-speed valve **35** may comprise a reciprocating high-speed valve like the one illustrated in International Patent Publication Number WO 00/31448, published June 2, 2000, or other types of electromechanical valves, venting schemes, or decompression ports. It is contemplated that a variety of gas supply, decompression chamber, and high-speed valve arrangements may be utilized in accordance with the present invention.

Additional features of the meat processing apparatus **10** of the present invention include an automatic controller, for monitoring and controlling the pressurization and decompression of the decompression chamber **40**, and noise damping or absorbing structure, for reducing noise generated by the blast of released gas.

Having described the invention in detail and by reference to preferred embodiments thereof, it will be apparent that modifications and variations are possible without departing from the scope of the invention defined in the appended claims. More specifically, although some aspects of the present invention are identified herein as preferred or particularly advantageous, it is contemplated that the present invention is not necessarily limited to these preferred aspects of the invention.

What is claimed is: